

Analysis and Design Tools for Fluid-Structure Interaction with Multi-Body Flexible Structures, Phase I

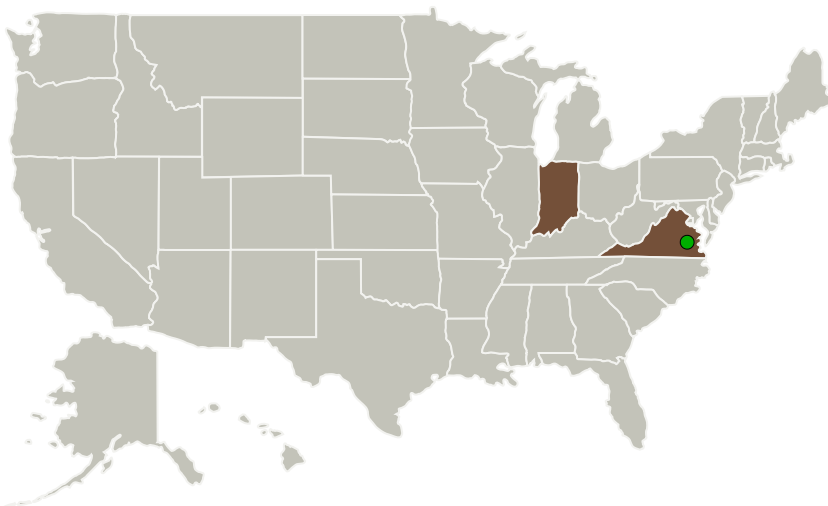
Completed Technology Project (2010 - 2010)



Project Introduction

The overall objective of this proposal (Phases I and II) is to develop a robust and accurate solver for fluid-structure interaction computations capable of addressing multi-body flexible structures as well as rigid body motion. The fluid flow solution will be performed using our unstructured solution-adaptive flow solver TETHYS. We propose to develop a structural solver based on the Galerkin finite element method and to couple structure and fluid strongly using an immersed boundary method (IBM). We will employ operator overloading to perform automatic code differentiation so that sensitivity and adjoint analysis can be performed on the coupled code. We will couple to parameterized CAD geometry and to the state-of-the-art optimization modules in the DAKOTA toolkit to perform optimization of fluid-structure interaction problems. In Phase I, we will (i) establish the feasibility of the immersed boundary method across the range of Mach numbers, (ii) develop a tightly coupled algorithm for fluid and structure, and (iii) demonstrate that sensitivities and Jacobians may be computed seamlessly and accurately for fluid-structure interaction. Though the focus of the proposal is on fluid-structure interaction problems of specific interest to NASA, the methodology will be applicable to a wide range of commercial CFD applications as well.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Jabiru Software and Services	Lead Organization	Industry	West Lafayette, Indiana
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Indiana	Virginia

Project Transitions

▶ **January 2010:** Project Start

✓ **July 2010:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138817>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Jabiru Software and Services

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

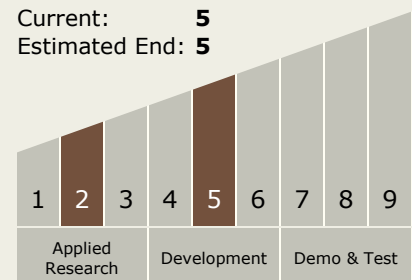
Carlos Torrez

Principal Investigator:

Rajesh Nair

Technology Maturity (TRL)

Start: 2
Current: 5
Estimated End: 5



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.3 Aeroelasticity

Target Destinations

The Sun, Earth, The Moon,
Mars, Others Inside the Solar
System, Outside the Solar
System